INDIA RUBBER
AND
VULCANIZED RUBBER FABRICS

Chas Goodyear

BORN AT NEW HAVEN, CONN., DEC. 29, 1800; DIED AT NEW YORK CITY, JULY 1, 1860

INDIA RUBBER

AND

VULCANIZED RUBBER FABRICS,

ADAPTED TO

MECHANICAL PURPOSES.

THE OLDEST, LARGEST, AND BEST.

NEW YORK BELTING and PACKING COMPANY.

JOHN H. CHEEVER, - - TREASURER.
J. D. CHEEVER, - - - DEPUTY TREASURER.

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INDIA RUBBER

AND

VULCANIZED RUBBER FABRICS.

INDIA RUBBER, in some form, is used for an almost infinite variety of purposes, and yet its nature, whether in those particulars attributable to different growths, and a somewhat different plant, or the various modifications and changes effected during the process of manufacture, is generally very imperfectly understood. The mechanic or the artisan, especially if contriving new machinery, or endeavoring to perfect appliances which will work more economically and produce and improved product, finds in India Rubber a material which at once suggests many possibilities, and has the advantage of already being in extensive use for a wide variety of purposes. In all experimental contrivances, therefore, it deservedly takes a leading place, and it is important that those who use it, should have some knowledge of the different qualities of the gum itself and the principles of its manufacture, so that they may be the better able to judge of the extent of its probable usefulness under various methods of preparation. A great proportion, also, of those who use rubber in machine belting, hose, packing, springs, etc., where the amount of goods manufactured has now reached an enormous scale, may not find it unprofitable to give some attention to the subject, to the end that they may be able to care more understandingly for the preservation and prolonged wear of rubber goods; it may, likewise, lead them to

discriminate more closely in their purchases, and avoid such products as are of imperfect or unskillful manufacture, or those made with the adulterating compounds so often introduced in low-priced articles, which invariably prove the most expensive in the end, frequently causing endless annoyance if not great loss, from the breaking down of machinery at a critical time.

For the purpose, therefore, of affording in a condensed form, information relative to India Rubber and its manufacture, which may be of interest and value to our customers and all users of rubber goods, we present this account, and the accompanying illustrations, showing different varieties of the plant, and how the gum is collected and cured, with the various processes of manufacture, as conducted at our works on the Potatook River, near Newtown, Conn. The commencement of the manufacture was, with us, contemporaneous with the period of many of the later discoveries of the great inventor whose name will ever be indissolubly connected with this industry, and starting with Charles Goodyear's personal assistance in the early days of the business, we have been enabled to carry forward his ideas, as it were, and, by our own prolonged and costly experiments, to greatly enlarge and develop a department of human activity which has been of vital importance in many modern industries. Of the value of rubber, in the different shapes which Charles Goodyear's invention made its use possible, an eminent English writer recently stated: "It holds such an important position with regard to the economy of modern arts and manufactures that, were it suddenly to be withdrawn from circulation, many minor industries would in consequence cease to exist, while numerous large and important branches of handicraft would languish, until arrangements could be made to adapt their operations to the altered circumstances." There have been but few adaptations of rubber since Charles Goodyear's time, which did not come within his conception of the uses to which it might eventually be put, but in order to make more perfect goods, or articles designed for novel purposes, we have in all these years been constantly adding new and costly machinery, have obtained many subsequent patents for valuable improvements, and have been enabled to select a large corps of workmen especially skilled in this line; our facilities for the furnishing of such goods have, therefore, steadily kept pace with the increasing demand, so that we believe ours is to-day not only the oldest but the largest manufactory of the kind in the world.

Although crude rubber, or caoutchouc, had been known for about five hundred years, and had been made to do some duty in an unimportant way by the natives of India, the West Indies and South America, it was not until within the past forty years that any way was discovered of successfully treating it for the manufacture of such articles as we are now all familiar with. The natives made shoes and a rough description of waterproof fabrics of the elastic gum, and an early English patent was for dissolving rubber in coal oil or naptha, and using the solution as a waterproofing agent. The peculiar properties of the gum attracted the attention of investigators connected with nearly all the learned societies of Europe, and called forth many

FICUS ELASTICUS, OR EAST INDIA RUBBER TREE.—A SPECIMEN GROWING IN OPEN AIR AT PARIS.

profound treatises from eminent scientists; but it was not until the success of Charles Goodyear's vulcanizing process was established--whereby rubber was made capable of resisting to a considerable extent both heat and cold—that the wide field was opened for its use which it has since occupied. The history of Charles Goodyear's life, as connected with the birth of the

India Rubber business, has many times been written; but the *Scientific American*, in a recent reference thereto, says:

"Among inventors and patentees especially, the thrilling story will ever awaken profound attention; how this yellowish white sap of a tropical tree, turned to gum by evaporation—originally called India Rubber because it came from India and was used to *rub* out pencil marks—had baffled the efforts of the leading scientists of the world by its singular chemical properties, only to be at last worked up by an American mechanic into a substance adapted to a greater variety of uses than almost any other product of man's skill; with what untiring zeal, and through what manifold difficulties he labored many years for what practical men deemed a chimera; the expensive litigation to which he was put to defend his patents when success had been fairly won, so that even the award of the gold medal at Paris, 1855, accompanied by the Grand Cross of the Legion of Honor, found him in a debtor's prison—down to his final triumph in "the great India Rubber case," when the legal declaration of his rights was finally reached through the last efforts in public life of Daniel Webster, but a few weeks before the death of the latter at Marshfield; all of these details, trite as may be the facts to many men now in middle life, can never fail to come home with touching eloquence to every American citizen, and to her mechanics and artisans especially."

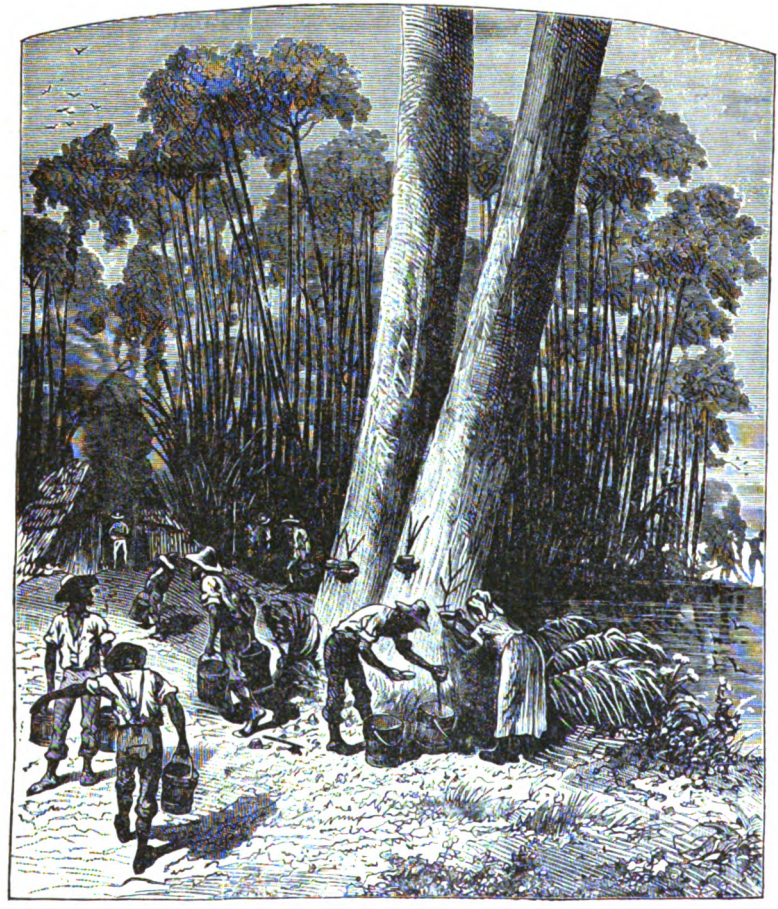
The rubber tree first known was the *Ficus Elasticus* of the East Indies, although Columbus found Rubber used by the natives of America at the time of its discovery in 1492. The preceding illustration of the Eastern plant is from a specimen now growing out of doors in the Parc Monceau at Paris. The tree in India grows to a height of a hundred feet; it yields abundantly of the caoutchouc gum or sap, and the trees are very numerous in some sections, but the percentage of caoutchouc in the sap is much less than that afforded by the South American trees.

The principal sources of the rubber supply now are South and Central America, the best article coming from Para, in Brazil. It is estimated that the Valley of the Amazon at present yields about 15,000,000 pounds of rubber annually. The accompanying illustrations represent the flower and foliage of a prominent variety of the Para rubber tree, the *hevea guianensis*, and the common method of collecting the sap, and drying or curing it. The trees grow to a height of sixty or seventy feet, with a diameter of nearly three feet, and yield large quantities of caoutchouc, although it has been feared that the carelessness with which the natives have been in the habit of cutting them to obtain the sap would ultimately result in largely decreasing the supply. The sap or juice is collected much in the same way as that of the sugar maple tree in this country, incisions being made in the bark of the tree, beneath which are suspended shells, or clay or tin vessels, into which runs the thin and nearly colorless caoutchouc. A sufficient quantity having been thus collected, the moisture is evaporated, and the rubber smoke-cured in the following original way: A sort of bat is dipped into a pail filled with the juice, and then held in the smoke of a fire, as shown in the engraving, and this process is continued until the rubber on the bat becomes about an inch thick, when a cut on one side allows the bat to be removed, and the rubber is hung up to be still further dried. This method of curing makes it always easy to distinguish Para rubber, for the fire over which it is smoked is made of wild nuts, which, besides giving a very dense smoke imparts to the rubber a certain fragrant

HEVEA GUIANENSIS, OR PARA RUBBER TREE—FLOWER AND FOLIAGE.

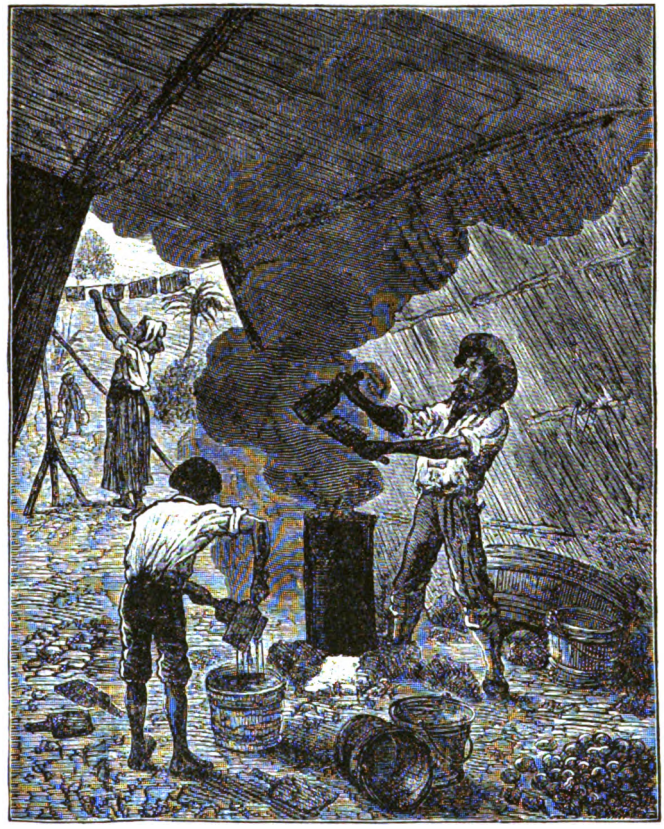
aromatic odor that is readily detected. The properties of crude Para rubber, when first collected, vary somewhat according to the age of the tree. and the particular locality where it is grown, but are about as follows:

Caoutchouc	33
Albuminous, extractive and saline matter	13
Water	54
	100



COLLECTION OF THE JUICE OF THE INDIA RUBBER TREE IN PARA.

Beside the foregoing sources of supply, Africa has, of late, been furnishing an article of rubber which seems to be well adapted for some classes of work. It is afforded by a vine-like plant which grows abundantly in Madagascar and also on the West coast. The vine is rough and knotty, about as thick as a man's arm, and grows to a length of fully two hundred feet. The leaves are glossy, like those of the South American Rubber Tree, and the



SMOKING AND DRYING THE INDIA RUBBER JUICE.

vine yields a fruit much liked by the natives. The rubber taken from the top of the vine is of better quality than that which comes from the bottom. The juice, after collection, is boiled in earthen vessels, a little salt being sometimes added in boiling the poorer qualities. After cooling, the rubber is fashioned according to the grade—ball, flake, mixed or tongue—and is then ready for market. This rubber contains so much water that 20 per cent. is deducted from its weight as purchased from the natives, which is about what the shrinkage on the voyage amounts to.

Although each kind of rubber has its specific characteristics, the differences shown by analysis are sometimes so slight as to be hardly noticeable, and the experience which comes

from long practice and close observation is indispensable to its successful manufacture. Prof. Bolas thus summarizes some of the leading points: "Like many other substances, it contains nothing but carbon and hydrogen, but its properties differ very widely from those of other hydro-carbons almost identical in composition. It has been found to contain in one hundred parts, 12.5 of hydrogen and 87.5 of carbon: it burns very readily and leaves no residue; it is soft and very imperfectly elastic in the true sense of the term—that is, it does not return to its old dimensions after being considerably stretched, but its elasticity may be enormously increased by vulcanization. As regards the stretching, there is a point at which it requires a greatly increased force to stretch it, and at this point it seems to become fibrous in texture. It has valuable electrical properties, being an admirable insulator, and having a great tendency to become electrical by friction. Freshly cut surfaces adhere very strongly when brought into contact, as shown by the old way of making a tube of unvulcanized caoutchouc, by wrapping a sheet round a mandrel so that the edges come together. Cold renders it rigid and inelastic, but on heating to 200° C., it becomes converted into a permanently viscous body, which has little or no tendency to harden again, the viscous substance possessing the same composition as unaltered caoutchouc." These are the characteristics, it is to be remembered, of raw rubber, which is hard and rigid at the freezing point, and so soft at 100° C., as to be of little value as an elastic material, the vital changes therein to fit it for the various uses to which it is mainly applied, being effected by its vulcanization and the various mixtures, principally sulphur and the oxides of lead, zinc, iron, etc., with which it is incorporated in varying proportions according to the class of goods being made.

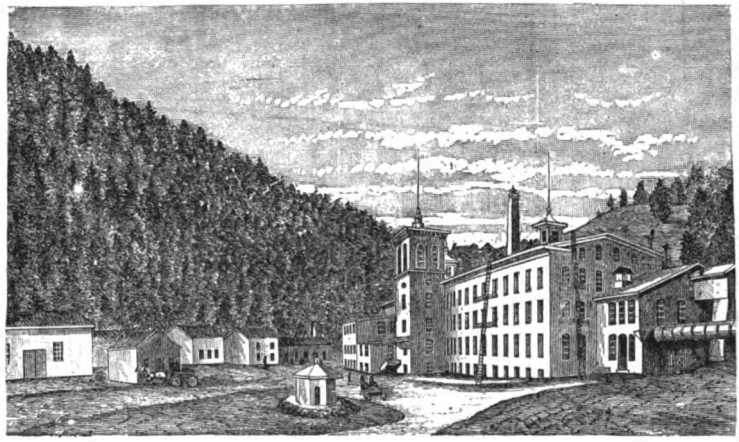
ESTABLISHMENT

OF THE

NEW YORK BELTING AND PACKING COMPANY,

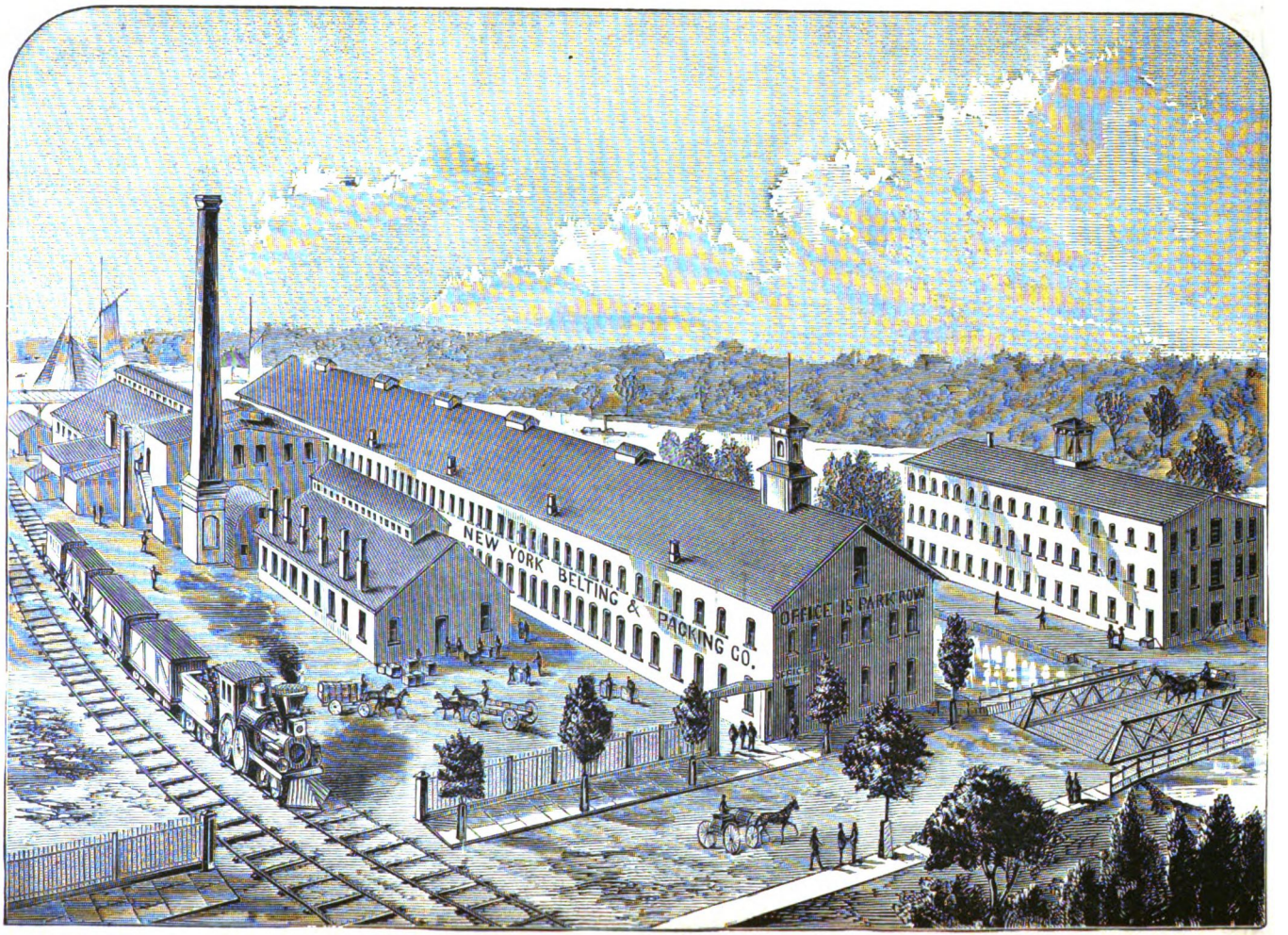
ON THE

POTATOOK RIVER, NEAR NEWTOWN, CONN.



VIEW OF LOWER FACTORY.

THE WORKS of the "New York Belting and Packing Company" are located in one of the most charming situations to be found in New England, as may be readily imagined from the illustrations herewith given, and from the view on the opposite page, showing the Potatook at the Mill Pond. It is but a short distance from the quiet but pretty Connecticut village of Newtown, and the drive from the latter place presents a scene of romantic beauty, the road winding through a deep and narrow valley, at whose bottom flows the Potatook River, while the banks are thickly wooded, except where the gray cliffs stand out boldly



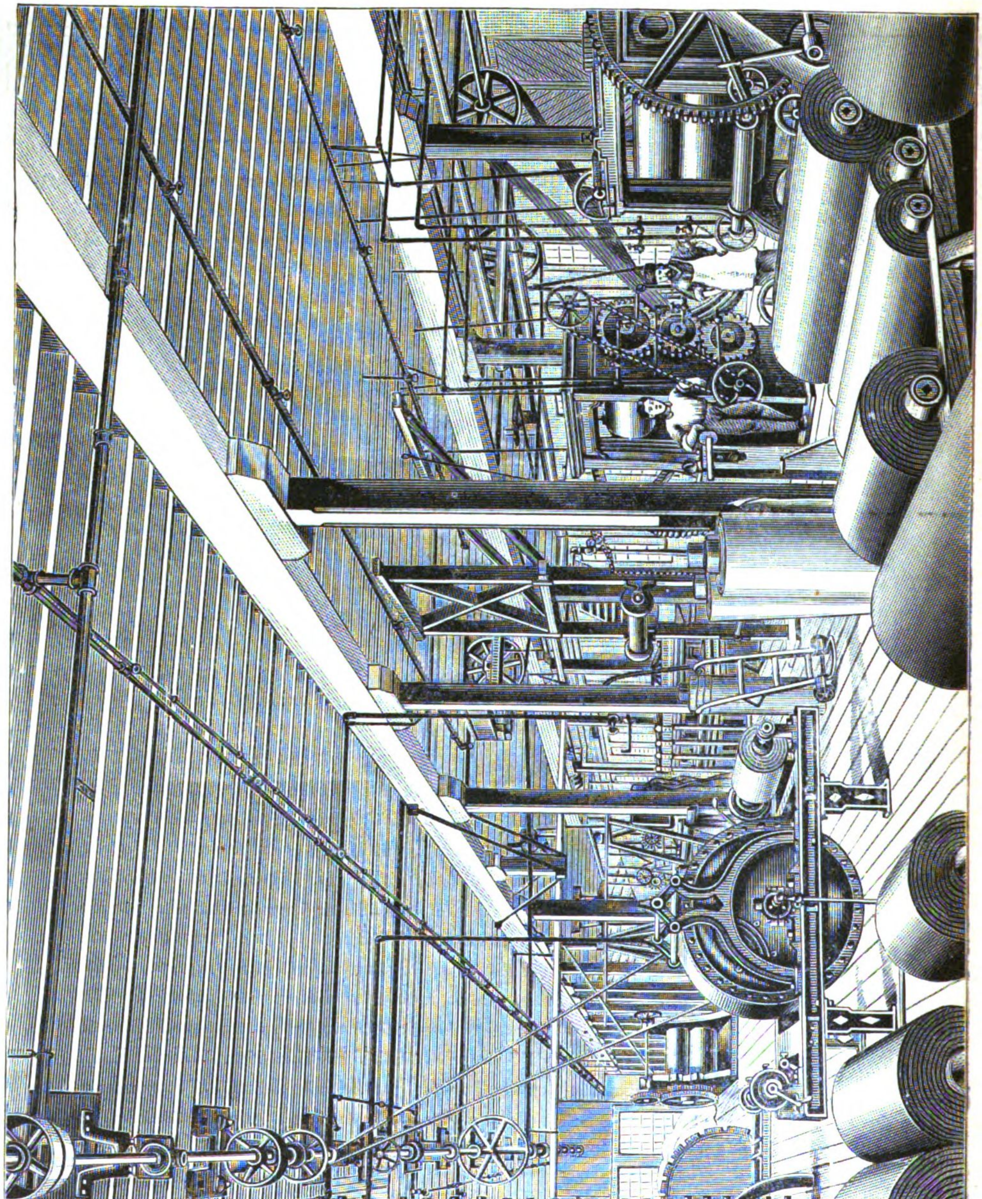
VIEW OF ANNEX FACTORY.

from the glen. The factory, with its outside workshops and storehouses, occupies a small level space below the mill-pond, while there is a house for the superintendent and cottages for the workmen on the sloping hillside opposite, the whole presenting a view of picturesque attractiveness seldom met with in a manufacturing village.

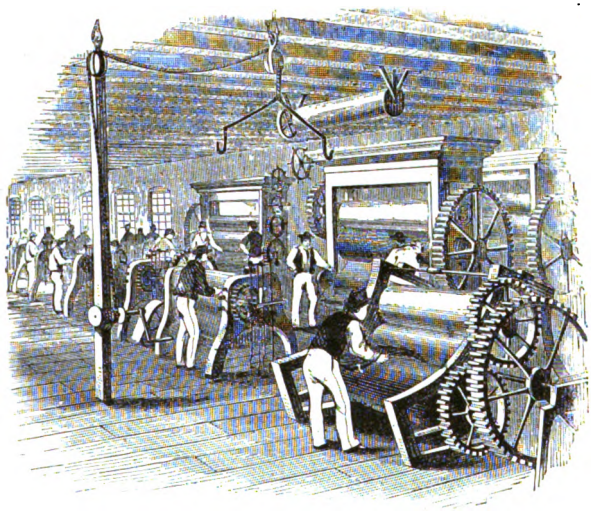
VIEW OF UPPER FACTORY.

The raw rubber used at the factory includes all the leading varieties, stacks of which are constantly kept on hand in the adjoining fire-proof storehouses, from whence it is taken as required for use in the several specialties for which the different varieties are deemed best suited. In all kinds of rubber the first step in the manufacture is to cleanse it of all foreign matter, it being more or less mixed with dust, bark, leaves, chips, and other extraneous substances, which become incorporated with it through carelessness, or from the desire of the natives to add something to the weight in this way. The process of cleansing is slow and laborious, and during the operation the rubber loses a material portion of its weight, from about 12 or 15 per cent. in the best qualities, up to as high as 40 per cent. in the cheapest kinds. It is first placed in a large vat of hot water and allowed to soak until the exterior is partially softened, when surface impurities may be removed, and the rude matting, woven in wide meshes, which in some cases surrounds packages of raw rubber, can be stripped off. The masses of rubber are then cut into slabs of about an inch in thickness by means of a large circular knife, between three and four feet in diameter which revolves with great speed, cutting the tough mass as easily as if it were clay. A good idea of this operation may be obtained from the accompanying illustration. From the cutters, the slabs of rubber are taken to machines called "crackers," invented for the purpose, and having large, deeply-grooved iron cylinders which revolve in pairs, and stretch

WASHER AND SHEETER.



and macerate the rubber in such a way as to drive out much of the bark, dirt and dust it contains, leaving less to do in the washing which follows. The machine for the latter purpose is also especially contrived for the work, and the way in which it is operated will be readily understood from the engraving. The rubber is placed in a large rectangular vat, in water kept hot by steam pipes, and while here is cut into small pieces by numerous sharp knives attached to a revolving shaft, the rubber, during the operation, undergoing something of a kneading and washing process quite like that employed in preparing the pulp for a paper mill. The water which the rubber takes up in this treatment, opens its pores, so that in the crushing, grinding and tearing operation to which it is afterwards



CALENDER ROOM.

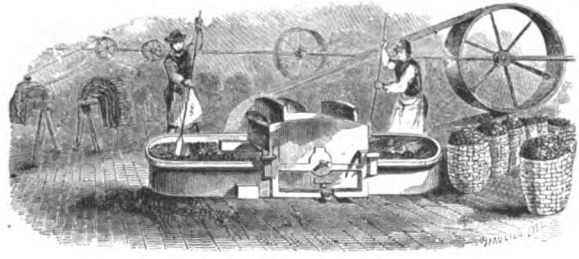
subjected, by being passed between plain-faced and fluted rollers, all of the mechanical impurities are removed. A stream of water is kept constantly flowing on the rubber while the rollers are effecting the disintegrating process, and the operation is continued for a longer or shorter period, according to the original condition of the rubber, until all extraneous substances have been removed, and nothing but pure rubber is left.

When the rubber leaves the rollers it is in the form of rough and broken-surfaced sheets, and the different workings have somewhat agglomerated the mass, without effecting a thorough mastication, a process which is afterward proceeded with where the articles to be manufactured therewith are to consist of pure, unvulcanized rubber. These sheets of

thoroughly washed rubber form the starting point from which all the manufacturing operations proceed, but they contain a good deal of water, and must first go to the steam-heated drying-room, where it will require from one to four months to thoroughly evaporate all the moisture they contain, without which the rubber would only be fit for inferior kinds of goods. The long delay necessary at this stage of the manufacture requires the keeping on hand at all times of an extensive stock of raw rubber in the washed and cured condition, ready for the subsequent operations.

CUTTING UP RAW RUBBER.

With the "mixing" process we come to a branch of the business of prime importance in the production of all first-class goods, and this is also a part of the work where the oportunity is offered for the introduction of large quantities of the utterly valueless cheapening substances so often incorporated with low grade-rubber fabrics. The operation of mixing will be readily understood from the engraving. It simply consists in passing the rough sheets, whose preparation has been previously described, between rollers heated from the inside, and gradually feeding in therewith the sulphur and other substances to be incorporated in the finished product. The rollers run at different speeds, and the sheets are continually passed and repassed between them, until the mixture has been thoroughly worked into the whole mass and evenly distributed in every part, making a rather stiff, homogeneous body, but one yet sufficiently plastic



WASHING RAW RUBBER.

to be moulded into any desired shape by the powerful machinery employed. Sulphur is the vulcanizing agent, and must form a part of all the mixtures used, about ten per cent. of the weight of the rubber constituting a very common proportion, although the amount varies

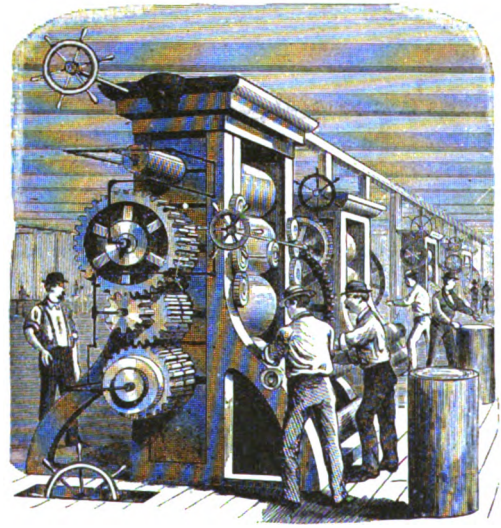
widely in lhe different articles made. It is highly important that the sulphur used should be free from acid, and also from the moisture which acid sulphur always takes up so rapidly on exposure to the atmosphere. Great care is taken in this particular, and all the sulphur used is carefully tested. The mixtures to be worked into the rubber are accurately weighed, so much mixture for so much rubber, each specific article having, besides sulphur, certain different ingredients and proportions of the oxides of lead, zinc, iron, etc., according as experience has indicated the most efficient compound for attaining the result desired. The future quality of the rubber is principally determined here, and, from thousands of experiments we have conducted during our long experience in the manufacture, we have been able to originate many improvements better adapting our products to the various specific purposes for which they are designed. The powders required to give rubber any desired color are here introduced, but the bulk necessary to effect this purpose is always very slight. The quality of vulcanized rubber for any special purpose cannot be very readily determined by one slightly acquainted with the business, except under the test of actual use; the pressure of a large proportion of inert matter greatly lessens its elasticity and reduces its strength; how difficult it is then for the chance purchaser to calculate upon the quality of the goods he obtains, may be inferred from the fact that it sometimes happens that as much as eighty per cent. of foreign matter goes into a product which is called "rubber," consisting principally of various earthy substances, clay, chalk, whiting, magnesia, silica, etc.

MIXING MACHINES.

After the mixing process has been thoroughly completed, the rubber is ready to receive the shaping for the final article to be produced, either by being pressed into moulds, or passed between heavy rollers to form it into thick sheets, and then through powerful calendering machines, the latter being heated by steam from the inside, and great care being taken to regulate the temperature, a different degree of heat being required for each kind of goods, and this varying to some extent during the operation. These machines are heavier than those used for calendering generally, and the one represented in the engraving is the largest ever made for this kind of work. The rubber is here rolled a great many times, some of it being finished in sheets and long strips pure, and some of it with the rubber, in successive operations, pressed upon a web of heavy cotton duck, previously coated with rubber driven through and through its meshes by powerful machinery. The fabric used for this purpose is made expressly for this establishment, and has more than double the strength of the heavy cotton duck used for sails for ships. This duck thus combined with the rubber gives the belting and hose subsequently made therefrom great tensile strength; and in hose, where the

tests can be most accurately made by gauging the exact pressure to the square inch, the strength has been proven to be about twice that of the best leather hose.

For belt making, the rubber-coated and impregnated duck is taken to a large department where this branch of the business is carried on, and unrolled, upon tables one hundred feet long, where the workmen cut it accurately to the required width. One strip is cut so that, folded, it will make the width of belt, and another, so that the wide strip will just fold over its edges and meet in the middle, which makes a three-ply belt. In this way the strips are passed between a series of powerful rollers, the temperature of which is evenly regulated, as in all the other operations; the folding over at the sides makes an even and perfectly uniform



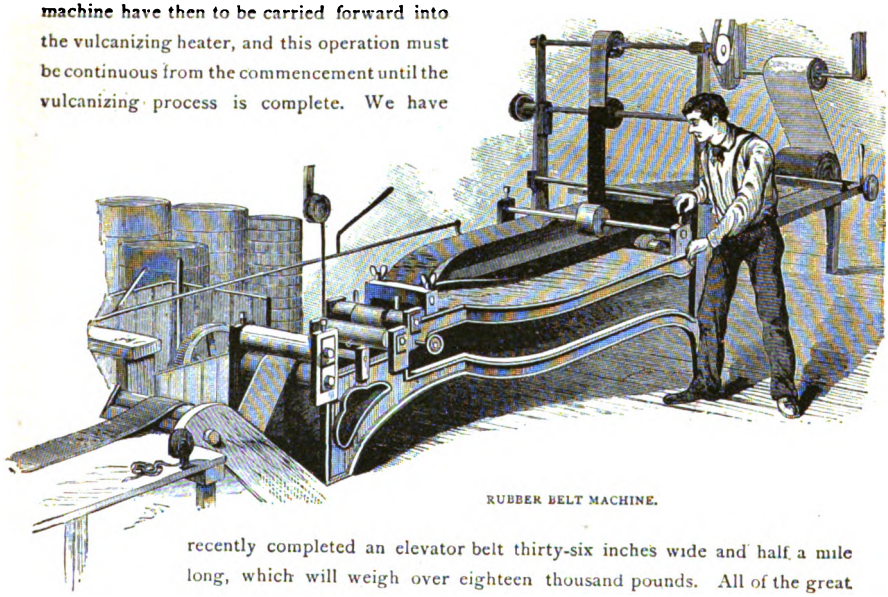
COATING AND CALENDERING.

half-round edge, and at the middle, where the edges of the outside strip come together, a narrow ribbon of rubber is fed to cover exactly the line of meeting. In this way the entire outside of the belt is pressed by the heated rollers into an even, regular surface, each different kind of belt showing the same form and weight for any number of feet, and presenting none of the irregularities in surface and thickness so often seen in leather belting where copper rivets are plentifully used, and where the substance of the hide varies so widely.

As the rubber surfaces, before being vulcanized, would stick together, they are rolled up with a thickness of duck between, and the belt-making machine has an attachment which takes up this fabric as the machine is fed.

The thicknesses of the regular sizes of rubber belts for most machine work are three-ply and four-ply, although two-ply belts are also made. The three-ply is generally compared with the heaviest single leather belts, and the four-ply with double leather belts. In making four-ply rubber belts, or in heavier ones when ordered, the width of the outside strip is calculated according to the two or more thicknesses over which it must be folded, and the operation then proceeds as in making the three-ply.

Our engraving gives but an incomplete idea of the room which these operations take up, for the long lengths of belting which have to be prepared previous to going into the machine have then to be carried forward into the vulcanizing heater, and this operation must be continuous from the commencement until the vulcanizing process is complete. We have

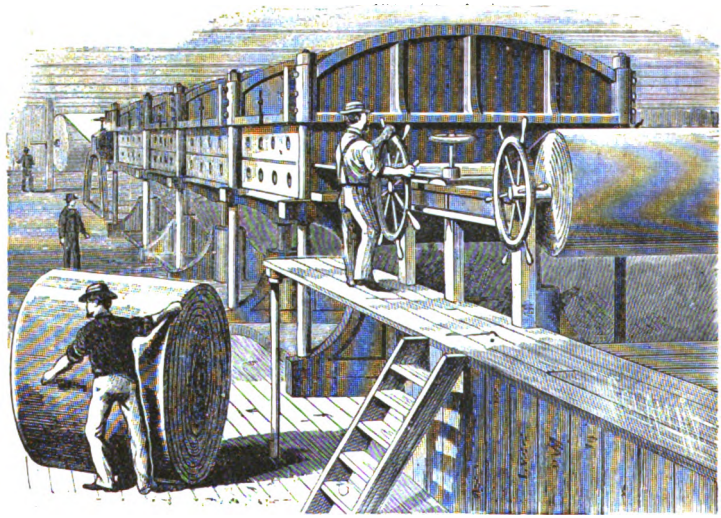


RUBBER BELT MACHINE.

recently completed an elevator belt thirty-six inches wide and half a mile long, which will weigh over eighteen thousand pounds. All of the great grain elevator belts in the country are of rubber, and the company have some of their big belts in Chicago elevators which have been running perfectly for twelve years. The metallic compound with which the rubber for belts is prepared, which we have through many years of experiment brought to its present state of perfection, gives its surface a high degree of firmness, while there is yet sufficient elasticity to allow of its hugging the pulley closely, which all machinists understand is necessary to enable a belt to work well; in the compound, also, as well as in the vulcanizing, attention is directed to making a belt which will resist a high degree of heat, so that the surface may not be injured by friction. All mechanics will understand that in putting on belts they should be stretched as

tightly as possible, and in large belts, where joints are strengthened by overlapping a thin piece of rubber or leather, the seam-side should always be outside; the closer the contact of the belt with the pulley, and the more perfect the exclusion of air from between belt and pulley, the better the service.

We have lately introduced an improvement of especial importance in our belting manufacture, by which the "stretch" can be thoroughly taken out of the largest sized belt. This we are able to do by the aid of the immense steam press represented in the accompanying engraving, the largest of the kind in the world, which has been completed within the past year. This press will take a belt six feet wide, and fifteen feet of its length, at once; it

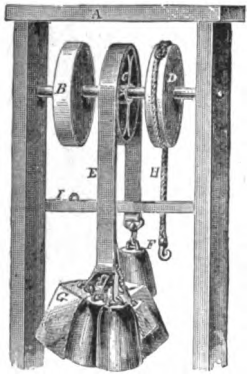


THE GREAT HYDRAULIC PRESS.

weighs 85,000 pounds; the steam is let into the bed and platen so that the temperature can be readily regulated; the platen is stationary, and the bed is lifted by hydraulic pressure. The most novel feature of this great press, however, is that it is arranged with appliances at each end for stretching the belts, so that, while the belt is under the full tension of the heaviest strain it may be desired to put upon it, it may at the same time be compressed between the hot plates, and thus set its fibres as firmly as a bar of steel. It does not seem very likely that an engineer would ever be troubled with having to "take up" a belt whose "stretch" had been taken out in this way. We own the patent for this stretcher in com-

bination with the press, as well as many other patents of great importance in the business. The principal Goodyear patent on vulcanizing expired in 1865, but we had then been many years manufacturing, and had obtained subsequent patents for improvements, some of which are of great value in the production of our staple goods at the present time.

As to the size of pulleys and amount of belting required to transmit a given amount of power, engineers and machinists differ widely in their views, and there is no recognized authority on the subject, in all that has been written in relation thereto, which so presents the matter that a practical mechanic or engineer fitting up a factory would depend on the calculations which have been elaborately worked out for their guidance. When a belt slips on a pulley, however, its usefulness is generally gone, or at least largely diminished, and this happens far more frequently with leather than with rubber belts. To place this matter entirely beyond question, accurate tests were made by us some years ago, the results of which —[and the facts they established have never been questioned]—were noticed at the time by the *Scientific American* as follows:



TESTING RUBBER VS. LEATHER BELTS.

EXPERIMENTS WITH BELTING.—It has long been a question of great interest to all who use belting to drive machinery, whether leather or vulcanized rubber hugged the pulley the best, and hence was less liable to slip. The manufacturers of both articles have been in the habit of talking "considerable high" on this subject, each, of course, making it as "clear as mud" to the intelligent listener, that their own particular manufacture was an illimitable number per cent. better than any one else's.

To satisfactorily decide this point, J. H. Cheever, Treaurer of the New York Belting and Packing Co., Park Building, this city, made a series of experiments, which we had the pleasure to witness, by the aid of the simple device that we have illustrated. It consists of three pulleys mounted on an axle or shaft in a frame, A. Pulley B was covered with rubber; C was a polished iron pulley, such as is ordinarily used in machine shops, and D was covered with leather. In the first experiment a leather belt of good quality, three inches in width, and seven feet long, was placed over the pulley, with thirty-two pounds suspended from each end. Weights were then added at one side until it began to slip over the pulley, and results were as follows:

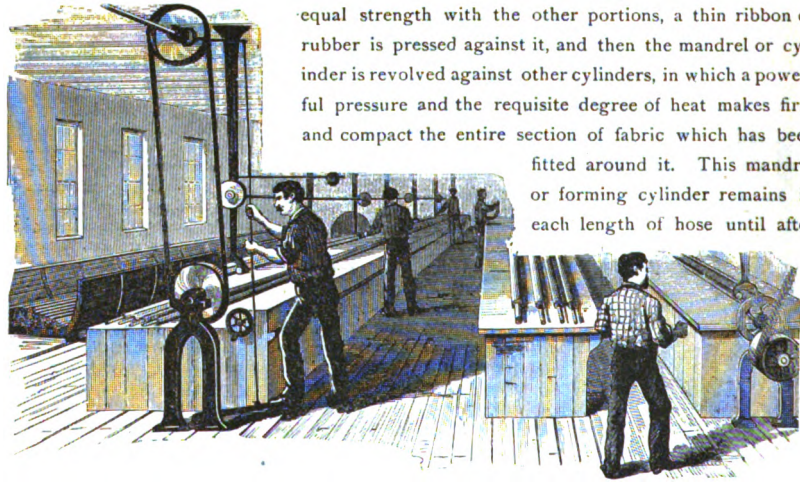
Leather Belt on iron pulley slipped at 48 pounds.
" " leather " " 64 "
" " rubber " " 128 "

This arrangement is shown by E, F, G. The next experiment was with vulcanized rubber. A three-ply belt of the same width, length and thickness as the leather one, was chosen, and being loaded with thirty-two pounds to keep it "taut," weights were added, as in the former instance, and the result was as follows:

Rubber belt on iron pulley slipped at 90 pounds.
" " leather " " 128 "
" " rubber " " 183 "

The pulleys were held fast by having the axle or shaft clamped to the frame. The experiment was then tried in another way. One end of the belt was secured to a staple, I, in a cross-piece, and the other being thrown over the pulley, B, was weighted with thirty-two pounds. A rope was passed round the pulley, D, and secured to it, and the free end of the rope weighted. The results were the same; and it took nearly the same weight to rotate the pulleys under the belt as it did to slip the belt over the pulley.

In the making of rubber hose, special care is taken in the first place in the selection of the best kinds of raw rubber for the particular description of goods to be manufactured, different mixtures being used, and the treatment varying in all the processes in order to obtain the exact condition and temper which will allow the rubber to be best applied to and incorporated with the duck, to give the greatest amount of strength. The lengths and widths required for the making of each piece of hose are cut from the long strips previously made ready in the calendering machine, and then wrapped around long cylinders or mandrels not tightly, but so that the freshly-cut edges of rubber will just meet. The rubber is then in such condition that, on the edges being pressed together, they unite so firmly as to hold with great tenacity, but to make the joint more firm, and of equal strength with the other portions, a thin ribbon of rubber is pressed against it, and then the mandrel or cylinder is revolved against other cylinders, in which a powerful pressure and the requisite degree of heat makes firm and compact the entire section of fabric which has been fitted around it. This mandrel or forming cylinder remains in each length of hose until after

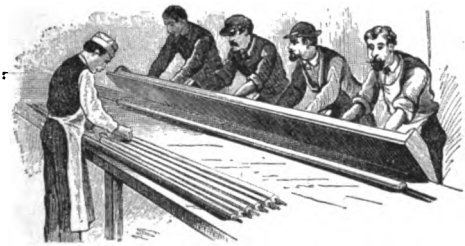


HOSE MACHINES.

the subsequent vulcanizing process has been completed; but, to prevent the rubber sticking to it, the rubber is coated with a powder, as soapstone or steatite, or some substance which will answer that end. Some idea of these operations may be obtained from the accompanying illustration. When hose is made over brass or galvanized iron wire, or the latter is entirely imbedded therein, so that only a smooth rubber surface shall be presented outside and inside, this is effected by working the different layers successively, and then, as in other kinds of hose, subjecting each to powerful pressure by heated rollers before vulcanizing. Although the materials used are somewhat different, and the working varies accordingly, this is substantially the way in which all kinds of hose are made, from that of

half an inch in diameter to that which is ten inches—from the common garden hose to that made for the steam fire engine, which will stand a pressure of over four hundred pounds to the square inch. It has been repeatedly demonstrated that rubber hose was far stronger than that made of leather, but its principal advantage, aside from its much higher tensile strength, lies in the fact that it requires no care, only to be hung up to dry after use, while leather hose must frequently be "stuffed" with oil and tallow, etc., after the manner a currier finishes leather, only the stuffing must be forced inside of the hose, making the operation more difficult. For these reasons the use of leather hose is steadily being relegated to the small country towns where only hand engines are used, and where the volunteer firemen have ample time to devote to leather dressing.

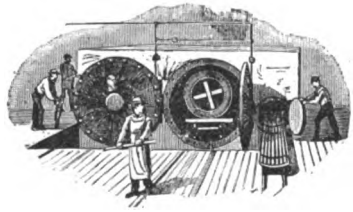
Tube making covers the production of a great variety of goods, and tubes are made either of pure rubber or with cloth insertion. Their manufacture proceeds on substantially the same principles as the hose making, except that from their small diameter they are, after being formed on the mandrel, rolled and finished for the vulcanizing by hand, as shown in the engraving. Where the square packing is made ready for vulcanizing, the rubber is furnished in sheets and plates of different sizes and shapes for regular articles, either pure or with cloth insertion, but where irregular shapes and forms are wanted, which cannot be cut out of the standard products, they must be made in moulds, not cast, as many suppose, and the rubber, after having been prepared by mixing and otherwise, as in the other operations, must be pressed into the moulds. In this way the corrugated matting, stair pads, car springs, etc., are made. The demand for this packing in steam work, to pack around piston rods, and wherever there is a joint where the metal is subjected to different degrees of temperature in valves, etc., is enormous, and only an engineer who has had experience with the materials formerly used for this purpose can fully realize its value for such use.



RUBBER TUBING.

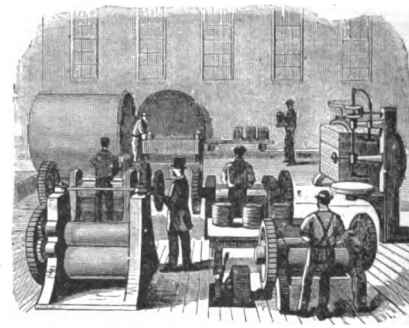
The last and most important of all the operations in the rubber manufacture, however, and one without which all the other steps would have been worthless, is the vulcanizing. This is the part of the work which was so long the subject of investigation before Charles Goodyear finally worked out the problem. It consists in subjecting the rubber, mixed with its proper proportion of sulphur, to a certain degree of heat for a special length of time, the amount of heat and the time necessary varying according to the mixture, the kind of rubber

and the article to be made. Whatever other foreign substances enter into the compound, it is the sulphur which, by making a chemical union with the rubber, effects the vulcanization, and yet it is only mechanical absorption, and not chemical union, which would be effected if the degree of heat were not above a certain point which ranges from about 240° to 300° F. To make ebonite or hard rubber, a greater amount of sulphur and a longer subjection to heat is necessary. The kind of ovens necessary for this purpose are shown in the engraving, some of them being one hundred feet long: they are arranged with thermometers, for the purpose of accurately gauging the temperature, and are made somewhat like steam boilers, tracks running into them, on which long platforms laden with articles to be vulcanized may be rolled in. These ovens are heated by steam, coming directly from the boiler, the heat and pressure being gradually raised and then steadily maintained, as upon the care with which this is attended to, and the nice distinctions necessary in making the different articles, much depends as to the strength and elasticity of the future product.



VULCANIZING HEATERS.

In particular is this important in the manufacture of our patent solid emery vulcanite wheel, the complete success of which was only attained after years of laborious application, during which we made thousands of costly experiments, and constructed therefor elaborate and costly machinery.

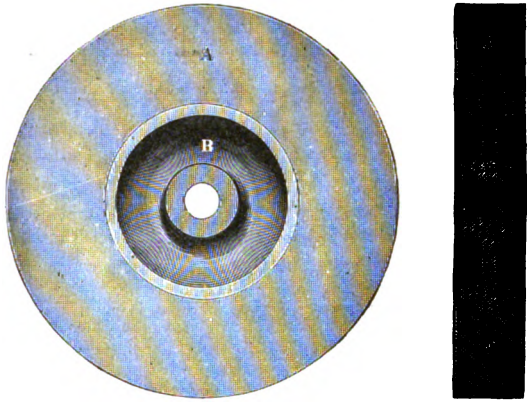


VULCANITE EMERY WHEELS.

SOLID EMERY VULCANITE WHEEL.

MADE ON CAST-IRON CENTER.

SIDE VIEW. SECTIONAL VIEW



A – Emery Vulcanite Rim.

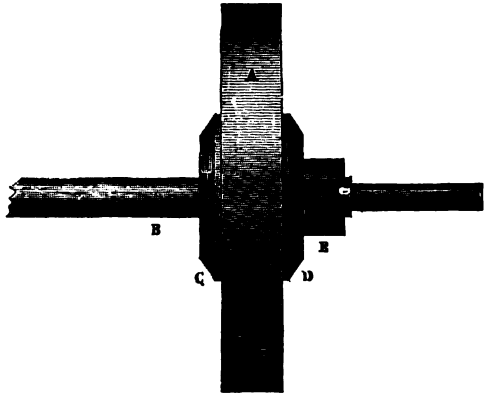
B—Cast-Iron Center. .

The ends of the hub must be flush with the sides of the wheel, as drawn. and not project beyond.

SOLID WHEEL—MOUNTED.

12 IN. DIAMETER; 2 IN. WIDE.

FRONT VIEW.



A, Emery Vulcanite Wheel; B, Mandrel; C, Fixed Flange; D, Loose Flange; E, Nut to screw against Loose Flange.

HOW TO MAKE THE BEST EMERY WHEELS.

Starting with the most ample facilities, and using only the best rubber—presented peculiar difficulties, for the problem was far more complicated than any which came up in other departments of the vulcanizing process. Aside from the nice distinctions always necessary in the mixing and vulcanizing processes of the rubber manufacture, we had still more difficult points to overcome in making wheels which would be sufficiently strong to run at a circumferential velocity of from 5,000 to 7,000 feet per minute, and which would have only just enough rubber in them to bind the emery closely, so that the wheels would wear perfectly even without glazing, would not soften by heat nor become brittle from cold, and would be throughout of such uniform texture and density that their work could always be depended upon. How well we have succeeded is evidenced by the fact that, beside a large home demand for these wheels, we have constant orders for them from leading manufacturers of cutlery and machinery in every part of the world where the best qualities of wheels are used.

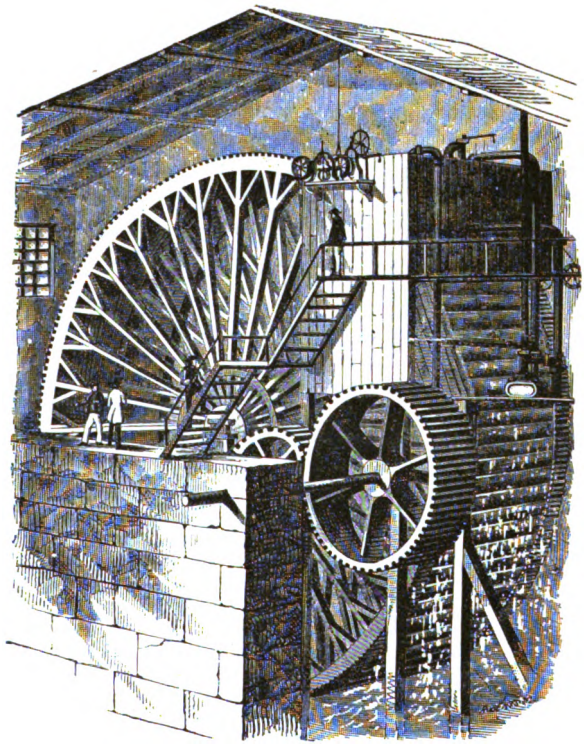
The preceding engravings represent a portion of the department in our factory where these wheels are made, and also side and sectional views of the wheel.

In reference to this branch of our business, the *Scientific American*, in its issue of November 6th, 1880, had the following:

EXPORTATION OF VULCANITE EMERY WHEELS.

The New York Belting and Packing Company have been receiving for some years large orders for their vulcanite emery wheels from England, where they are used in the Government arms manufacturing works at Enfield, near London. They have, also, for a considerable time back been supplying these wheels for the use of both English and Continental manufacturers of fine cutlery, machine tools and implements of precision, their superiority over English emery wheels for nearly every kind of grinding, cutting and finishing being thus practically recognized. There have been but few improvements which have within the past twenty years worked such important changes in the way of economizing work in the machine shop and finishing room as has been effected by the emery wheel. The many different grades in which it is made, each different from the preceding by the slightest variations, fit it alike for almost every kind of grinding and polishing. Its handiness and general adaptability have enabled it to drive out the use of the grindstone, to a great extent, in the saving of files to the value of millions of dollars, and greatly reducing the amount of work for which lathe tools were formerly used, so that it is now generally employed by workers in wrought, cast, and chilled iron, hardened steel, slate, marble, glass, etc. In the making of hardware, cutlery, and edge tools, it has become indispensable, while it has also effected a great saving of labor in the manufacture of plows, safes, stoves, agricultural implements, and small machinery of every description. It is, therefore, a matter of considerable credit to American

inventive genius and mechanical skill that the rest of the world should be indebted to us for the introduction and continued manufacture of the best articles in so important a specialty. The success of the Company in this field, almost within the bailiwick, as it were, of a business in which England claims especial preëminence, is particularly creditable to its managers and to their goods, and cannot fail to be gratifying to American mechanics generally.



Although we have admirable water power facilities at our factory on the Potatook River, we were many years since obliged to supplement this motor with steam, which now drives most of our machinery. The great water-wheel, however, over fifty feet in diameter, a good illustration of which may be seen in the above engraving, still furnishes a valuable adjunct,

and in the testing of hose, as well as in moving the powerful machinery required to manipulate and mould large masses of rubber at once, the full power of both steam and water is sometimes in demand, although the immense, heavily-revolving wheel seems to move with a force which would, of itself alone. be irresistible

1883.

PRICE LIST

OF THE

NEW YORK

BELTING AND PACKING

COMPANY,

THE OLDEST AND LARGEST MANUFACTURERS IN THE UNITED STATES OF

VULCANIZED RUBBER FABRICS

ADAPTED TO

MECHANICAL PURPOSES.

WAREHOUSE, 15 PARK ROW,

P. O. BOX 2180. NEW YORK.

JOHN H. CHEEVER, TREASURER.

OUR MANUFACTURING ADVANTAGES.

WE HAVE THE LARGEST FACTORIES OF THE KIND IN THE WORLD,

—WITH—

MACHINERY OF THE MOST APPROVED DESCRIPTION,

And over Thirty-five Years' Experience in the Manufacture of Vulcanized Rubber for Mechanical Purposes.

We are the Owners of numerous valuable Patents covering different Processes incidental and indispensable to the making of

BELTING, PACKING, AND HOSE

IN THE BEST MANNER;

And particularly for Machine Belting Vulcanized between Layers of a Patent Metallic Alloy, by which the Stretch is entirely Taken Out, the Surface Made perfectly Smooth, and the Substance Thoroughly and Evenly Vulcanized,

All of which are of the greatest importance. It will be our aim not only to maintain the

HIGH STANDARD OF EXCELLENCE

WHICH HAS HITHERTO

Characterized our Manufactures and given them a Good Reputation

with consumers, but to make every resource available for their improvement; and we particularly invite a trial of our manufactures by all dealers and consumers who want the

BEST QUALITY IN THE MARKET

—AT—

AS LOW PRICES AS CAN BE AFFORDED.

Any further information pertaining to the business may be obtained by mail or otherwise, on application to

NEW YORK BELTING AND PACKING CO.,

P. O. Box 2180. **15 Park Row New York.**

I

INDEX.

MACHINE BELTING.

WITH SMOOTH METALLIC RUBBER SURFACE.

This Belting is made of heavy Cotton Duck, weighing two lbs. per yard, woven expressly for the purpose, and is vulcanized between layers of a patent metallic alloy, by which process the stretch is entirely taken out, the surface made perfectly smooth, and the substance thoroughly and evenly vulcanized.

TWO-PLY.

(For Agricultural Machines, Railway Belts, and other light work.)

Inch.	Per ft.	Inch.	Per ft.	Inch.	Per ft.	Inch.	Per ft.
1	$0 07	4	$0 30	9	$0 67	15	$1 16
1¼	09	4½	33	10	75	16	1 25
1½	11	5	36	11	83	18	1 41
2	15	6	43	12	91	20	1 58
2½	18	7	51	13	1 00	22	1 76
3	22	8	59	14	1 08	24	1 96
3½	26						

THREE-PLY.

Inch.	Per ft.	Inch.	Per ft.	Inch.	Per ft.	Inch.	Per ft.
2	$0 17	5	$0 43	11	$1 00	18	$1 70
2½	22	6	52	12	1 08	20	1 90
3	26	7	60	13	1 18	22	2 12
3½	30	8	70	14	1 28	24	2 36
4	34	9	80	15	1 38	26	2 60
4½	39	10	90	16	1 50	28	2 84

FOUR-PLY.

Inch.	Per ft.	Inch.	Per ft.	Inch.	Per ft.	Inch.	Per ft.
2	$0 21	8	$0 84	18	$2 02	34	$4 20
2½	26	9	95	20	2 26	36	4 48
3	31	10	1 07	22	2 52	38	4 76
3½	37	11	1 18	24	2 80	40	5 04
4	42	12	1 30	26	3 08	42	5 32
4½	47	13	1 42	28	3 36	44	5 60
5	52	14	1 54	30	3 64	46	5 88
6	62	15	1 66	32	3 92	48	6 16
7	73	16	1 78				

FIVE-PLY.

Inch.	Per ft.	Inch.	Per ft.	Inch.	Per ft.	Inch.	Per ft.
8	$1 05	15	$2 07	26	$3 85	38	$5 95
9	1 18	16	2 22	28	4 20	40	6 30
10	1 33	18	2 53	30	4 55	42	6 65
11	1 47	20	2 83	32	4 90	44	7 00
12	1 62	22	3 15	34	5 25	46	7 35
13	1 77	24	3 50	36	5 60	48	7 70
14	1 92						

SIX-PLY.

Inch.	Per ft.	Inch.	Per ft.	Inch.	Per ft.	Inch.	Per ft.
8	$1 26	15	$2 49	26	$4 62	38	$7 14
9	1 42	16	2 67	28	5 04	40	7 56
10	1 60	18	3 03	30	5 46	42	7 98
11	1 77	20	3 39	32	5 88	44	8 40
12	1 95	22	3 78	34	6 30	46	8 82
13	2 13	24	4 20	36	6 72	48	9 24
14	2 31						

ALL OTHER WIDTHS AT PROPORTIONATE PRICES.

We keep on hand all the odd half inches, up to six inches, at proportionate prices.

ENDLESS BELTS,

OF ANY WIDTH OR LENGTH,

MADE TO ORDER, AT TEN DAYS' NOTICE,

AT CURRENT LIST PRICES,

With an Additional Charge for the Joining, equal to the price of 3 feet of the belt.

Full rolls of belting, as manufactured for the trade, measure from 300 to 350 feet long; but we cut belts to order of any length required.

For belts less than 6 inches wide, the "3-ply" is sufficiently strong, unless the work is unusually heavy for the width. Belts wider than 6 inches should not be less than ' 4-ply," unless the work is unusually light for the width.

DIRECTIONS FOR LACING AND USING

VULCANIZED RUBBER MACHINE BELTING.

For narrow belts, butt the two ends together, make two rows of holes in each end (thus obtaining double hold), and lace with lacing leather.

For wide belts, in addition, put a thin piece of leather or rubber on the back to strengthen the joint, equal in length to the width of the belt, and sew or rivet it to the belt. The seam side of the belt should always be outside.

In putting on the belting it should be stretched as tightly as possible, and with wide belts this can be done best by the use of clamps secured firmly to each end of the belt and drawn together by bolts running parallel with and outside the edges of the belt. There is no danger of breaking, as a belt six inches wide and three-ply thick will stand a direct strain of five thousand pounds, and other sizes in proportion.

The belts will be greatly improved, and their durability increased, by putting on a composition with a painter's brush, and letting it dry, made of equal parts of "Black Lead and Litharge, mixed with boiled Linseed Oil, and Japan enough to make it dry quick;" the effect of this will be to produce a finely polished surface. Should the rubber, from any cause, get peeled off, a coat of the same composition may be applied.

If the belt should slip, from dust or other causes—which seldom happens—it should be LIGHTLY moistened on the side next the pulley with boiled Linseed Oil—ANIMAL OIL WILL NOT ANSWER. If one application does not produce the desired effect, repeat until it does.

GRAIN ELEVATOR BELTS.

We point with pride to the immense quantity of our Rubber Belting which has been running for years in the manufactories throughout our country and abroad, and invite examination of some of the Great Elevators which we have supplied, among which we may mention:—**David Dows' Stores, in Brooklyn,** the largest in the world, now using over **five miles in length of our heavy belts,** from 2 to 4 feet in width; **Vanderbilt's two great Elevators of the "N. Y. Central & H. R. R. R.,"** New York; those of the **"Erie R. R."** and the **"Pennsylvania R. R."** at Jersey City. To the latter we supplied the **"Champion Carrying Belt,"** the largest ever made of either rubber or leather, weighing **16,000** pounds and being **2,666** feet long; also, for **"Armour, Dole & Co.,"** Chicago, and **"J. & E. Buckingham, Illinois Central Elevators,"** who, after using our belts over fourteen years, write us:

"In the Summer of 1869, *we ordered of you for our Elevator 'B' a Driving Belt* 300 *feet long,* 48 *inches wide, and* 6*-ply thick. It has driven all the machinery of that Elevator—*300 *feet long,* 100 *feet wide, and* 145 *feet high—from the day it was first started to the present moment. It has done most excellent work; we expect it to last for many years, and are happy to testify to the excellence of its material and good workmanship."*

The following letter from Mr. Chas. E. Davis, Superintendent of the "Girard Point Storage Co.," Philadelphia, explains itself:

"In October, 1874, *we received from the New York Belting and Packing Co. thirteen Elevator Belts,* 20 *inches wide, nine Conveyer Belts,* 30 *inches wide, and two Main Driving Belts,* 36 *inches wide. They have been running continually since, part of the time night and day, equivalent to twelve years' ordinary running time. I have never had to patch or piece any one of them, and at the time our Elevator was destroyed by fire, last April, they were yet in an excellent condition, and bid fair to last for an indefinite period. I cheerfully recommend to those requiring heavy Belting the article manufactured by this Company, as I feel they will render entire satisfaction."*

RUBBER HOSE.

The base of strength in this Hose is Cotton Fabric, prepared expressly for the purpose in a way that gives the greatest amount of strength to a given quantity of material.

CONDUCTING HOSE. 2-PLY.

This is the thinnest Hose we make, and it is designed to conduct water under a moderate head or pressure only. The larger sizes are mainly used for Tank Hose at railway stations.

Internal Diameter.	Per foot.	Internal Diameter.	Per foot.	Internal Diameter.	Per foot.
½ inch	20 cents.	2 inches	$0 66	5 inches	$1 65
¾ "	25 "	2¼ "	75	6 "	1 98
1 "	33 "	2½ "	83	7 "	2 31
1¼ "	42 "	2¾ "	92	8 "	2 64
1½ "	50 "	3 "	99	9 "	2 97
1¾ "	58 "	4 "	1 32	10 "	3 33

HYDRANT HOSE. 3-PLY.

This Hose is of medium strength, suitable for hydrants, force pumps, garden engines, street sprinkling, washing decks, etc., where the pressure does not exceed 75 lbs. per square inch.

Internal Diameter.	Per foot.	Internal Diameter.	Per foot.	Internal Diameter.	Per foot.
½ inch	25 cents.	1¾ inches	$0 70	3 inches	$1 20
¾ "	30 "	2 "	0 80	3½ "	1 40
1 "	40 "	2¼ "	0 90	4 "	1 60
1¼ "	50 "	2½ "	1 00		
1½ "	60 "	2¾ "	1 10		

ENGINE HOSE. 4-PLY.

This Hose is designed to sustain a pressure of from 100 to 150 lbs. per square inch, and is recommended—particularly the larger sizes—for all general purposes where a good, strong, reliable Hose is required.

Internal Diameter.	Per foot.	Internal Diameter.	Per foot.	Internal Diameter.	Per foot.
½ inch	30 cents.	1½ inches	$0 75	2½ inches	$1 25
¾ "	37 "	1¾ "	0 87	2¾ "	1 37
1 "	50 "	2 "	1 00	3 "	1 50
1¼ "	62 "	2¼ "	1 12	4 "	2 00

All intermediate sizes to be charged at the list price of the next larger size, thus: ⅞ in. will be charged at one-inch price, etc.

All the above kinds of Hose are kept on hand in lengths of 25 and 50 feet; and THESE WE DO NOT CUT, but make to order, at one week's notice, any other lengths less than 50 feet.

We also make to order either 5 or 6-ply Hose, at an advance on 4-ply prices of 25 per cent. for each additional ply.

EXTRA HEAVY STEAM HOSE.

THREE-PLY. For 20 lbs. of Steam, or less.

Internal Diameter.	Per foot.	Internal Diameter.	Per foot.	Internal Diameter.	Per foot.
½ inch	45 cents.	1¼ inch	$0 90	2 inch	$1 41
¾ "	54 "	1½ "	1 07	2½ "	1 74
1 "	71 "	1¾ "	1 24		

FOUR-PLY. For 35 lbs of Steam, or less.

Internal Diameter.	Per foot.	Internal Diameter.	Per foot.	Internal Diameter.	Per foot.
½ inch	$0 54	1¼ inch	$1 10	2 inch	$1 74
¾ "	71	1½ "	1 31	2½ "	2 18
1 "	88	1¾ "	1 52		

FIVE-PLY. For 50 lbs. of Steam, or less.

Internal Diameter.	Per foot.	Internal Diameter.	Per foot.	Internal Diameter.	Per foot.
½ inch	$0 68	1¼ inch	$1 38	2 inch	$2 18
¾ "	89	1½ "	1 64	2½ "	2 73
1 "	1 10	1¾ "	1 90		

SIX-PLY. For 75 lbs. of Steam, or less.

Internal Diameter.	Per foot.	Internal Diameter.	Per foot.	Internal Diameter.	Per foot.
½ inch	$0 81	1¼ inch	$1 65	2 inch	$2 61
¾ "	1 07	1½ "	1 96	2½ "	3 27
1 "	1 32	1¾ "	2 28		

Winding with marline, 10 per cent. additional.

EXTRA HEAVY BREWERS' HOSE.

THIS IS ALSO A GOOD STEAM HOSE.

FOUR-PLY.

Internal Diameter.	Per foot.	Internal Diameter.	Per foot.	Internal Diameter.	Per foot.
½ inch	$0 51	1¼ inch	$1 04	2 inch	$1 66
¾ "	67	1½ "	1 25	2½ "	2 08
1 "	83	1¾ "	1 45		

5 or 6-ply made at an advance of 25 per cent. for each additional ply.

AIR BRAKE AND PETROLEUM HOSE.

Same LIST as Extra Heavy Brewers' Hose.

RUBBER SUCTION HOSE.

SUCTION HOSE.

ON SPIRAL BRASS WIRE.

Internal Diameter.	Per foot.	Internal Diameter.	Per foot.	Internal Diameter.	Per foot.
¾ inch	$0 77	1¼ inch	$1 25	1¾ inch	$2 10
1 "	1 00	1½ "	1 65	2 "	2 50

The above are the only sizes of Suction Hose that we keep on hand, and these we supply in any lengths required, not exceeding 50 feet.

LARGE SUCTION HOSE.

Suction Hose larger than two inches diameter we make to order, at about one week's notice, of any size and length required.

These larger sizes, up to twelve inches diameter, we make on flat galvanized iron, wound spirally, by which method we produce Hose unequalled for flexibility and service.

Internal Diameter.	Per foot.	Internal Diameter.	Per foot.	Internal Diameter.	Per foot.
2½ inches	$3 10	5 inches	$7 60	7½ inches	$13 50
3 "	4 00	5½ "	8 50	8 "	15 00
3½ "	4 90	6 "	9 50	9 "	17 50
4 "	5 80	6½ "	10 50	10 "	20 00
4½ "	6 70	7 "	12 00	12 "	25 00

PATENT "SMOOTH BORE" RUBBER SUCTION HOSE.

Manufactured under Patent No. 188,219.

Internal Diameter.	Per foot.	Internal Diameter.	Per foot.	Internal Diameter.	Per foot.
2 inches.....	$2 60	5 inches	$8 50	7½ inches	$15 00
2½ "	3 50	5½ "	9 50	8 "	16 50
3 "	4 50	6 "	10 50	9 "	19 50
3½ "	5 50	6½ "	12 00	10 "	23 50
4 "	6 50	7 "	13 50	12 "	27 50
4½ "	7 50				

Above sizes made to order, in any lengths required, at about ten days' notice.

Officers of Fire Departments, Builders of Fire Engines, and others will find in this new invention a PERFECT SUCTION HOSE, that in practical use will ***meet all requirements*** in the most satisfactory manner. The walls of this new Hose are stiffened and strengthened by a flat galvanized iron spirally wound coil, which is ***embedded*** in the rubber, entirely out of sight, so that it cannot be acted upon by water, or other fluids, nor displaced by any internal pressure, when used in connection with Fire Plugs or Hydrants.

The interior, or bore, being perfectly smooth and even, water will pass through it with less friction and more rapidly than through the old style Suction Hose, in which the exposed metal rings, or spiral coil, give it a rough, uneven interior, that considerably retards the passage of water through it. It is also stronger and much more flexible than the old style of Suction Hose, its flexibility being so great that a 4-inch "Smooth Bore" can without injury be coiled within a circle three feet in diameter.

In pumping pulpy or semi-fluid matter, such as would clog and render useless the old style Suction Hose, the "Smooth Bore" will prove very useful, as all such matter will pass freely through it.

HARD RUBBER SUCTION HOSE.

¾	inch.....	$0 65	per foot.
1	"	75	" "
1¼	"	93	" "
1½	"	1 13	" "
1¾	"	1 81	" "
2	"	1 50	" "
2½	"	1 88	" "

TEST HOSE.

VULCANIZED PARA RUBBER AND CARBOLIZED DUCK.

Patent No. 26,276; Reissue No. 6,545.

4-PLY, 5-PLY CAPPED ENDS. 400 lbs. per Square Inch.

"TEST."

This extra quality of Hose is made expressly for Steam Fire Engine use, and the results shown by the wear of our "Test Hose" in over 300 Fire Departments, including all the large cities, since 1868, warrants us in saying that it is unequalled in workmanship, strength, and durability, and as such we offer and recommend it to Fire Departments and others requiring a heavy Fire Hose. Like all our Antiseptic Hose, it is treated under heated pressure with Vaporous Carbolic Acid, to prevent mildew and rot. The 4-ply will stand a pressure of 400 pounds per square inch.

3-ply.		Per ft.	4-ply.		Per ft.	5-ply.		Per ft.
2 in.	4-Ply Capped Ends	$0 70	2 in.	5-Ply Capped Ends	$0 88	2 in.	6-Ply Capped Ends	$1 10
2½ "	" " "	88	2½ "	" " "	1 10	2½ "	" " "	1 37
3 "	" " "	1 05	3 "	" " "	1 32	3 "	" " "	1 65

ANTISEPTIC MULTIPLE COTTON FIRE HOSE.

"CABLE." Patented July 8, 1873, and September 16, 1879.

Our "Cable," which has been in use in the principal Fire Departments over four years, is a Rubber Lined Extra Heavy Seamless Cotton Fabric, Circular Woven in a manner differing entirely from all other Hose, and which has won for it a reputation unequalled for enduring great pressure, and long, severe service, without bursting. This method of construction produces a light, compact, and durable Hose, combining wear with strength and pliability, as the heavy ribbed cover woven on the outside of this Hose has to be destroyed before its strength is affected. Our Double Cable is the best wearing Jacketed Hose in the market.

To prevent mildew and rot, the Cable is treated under a heated pressure with vaporous carbolic acid by our patent process, and it is the only fabric Hose so prepared.

This Hose is made in graduated weights, according to the purposes for which it is needed.

THE ANTISEPTIC DOUBLE CABLE HOSE

Is especially adapted to Fire Department service, and is comparatively indestructible, the outer covering being easily removed and a new one put on at a light cost. The attention of Chiefs and Heads of Fire Departments in large cities is especially directed to this brand of Cable.

THE FIRE SERVICE RECORD OF CABLE HOSE IS UNSURPASSED.

STAR LINEN HOSE.

UNLINED.	Per foot.	RUBBER LINED.	Per foot.
1 inch diameter	24 cents.	1 inch diameter	36 cents.
1¼ " "	27 "	1¼ " "	40 "
1½ " "	30 "	1½ " "	44 "
2 " "	34 "	2 " "	54 "
2¼ " "	37 "	2¼ " "	59 "
2½ " "	40 "	2½ " "	65 "

LARGER SIZES MADE TO ORDER.

This Hose is woven of fine flax, without seam, in any lengths desired. It is the only suitable article for use where a light and serviceable Hose is required for fire protection, on Stand pipes, in Flats, Stores, Hotels, Theatres, &c., amongst which in our city there are some 30,000 feet of this Hose in use, to which we are at a liberty to refer. It occupies but little space, and only needs to be kept dry when not in use to last for years.

Rubber Lined is recommended, as it prevents all sweating or leakage, and adds greatly to the durability of the Hose.

EMPIRE BRAND LINEN HOSE.

Diameter	1	1¼	1½	2	2½ inch.
Plain	18	20	22	24	26 cts. per foot.
Rubber Lined	33	36	40	47	54 " " "

"CABLE" ANTISEPTIC COTTON HOSE.

Patented July 8, 1878, Sept. 16, 1879.

	Per foot.		Per foot.
¾ inch Cable	20 cents.	2½ inch, No. 2, (300 lbs.)	70 cents.
1 " "	40 "	2½ " " 3, 400 "	80 "
1½ " "	50 "	2½ " " 4, 500 "	$1.00
2 " "	60 "	2½ " Double Jacket	1.00

No. 2 is a light grade of Cotton Hose, for factory purposes.

No. 3 is for use on hand engines and small steamers.

No. 4 and Jacket are recommended for Steam Fire Engines in large cities, and wherever endurance under heavy pressure is required.

WE SUPPLY ALL THE DIFFERENT STYLES OF HOSE COUPLINGS AND PIPES.

In ordering Hose with couplings, a sample coupling should be sent us, that we may get the correct thread.

STEAM PACKING.

Rubber Steam Packing, in its various forms and applications, is now an indispensable article to the engineer in conveniently keeping his steam machinery and fixtures in proper working condition. Possessing great elasticity, it will stand 300 degrees of heat; hence for packing steam joints no satisfactory substitute for it can be had, particularly where the iron surfaces of the parts to be made tight are rough or uneven. We supply it in every possible form to meet the requirements of engineers and machinists, either in SHEETS of any thickness to cut up for steam or water joints; in GASKETS of any size, shape, or thickness, for packing manhole or handhole plates, cylinder heads, steam chests, pipe flanges, etc.; in ROUND OR SQUARE STRIPS for packing the stuffing boxes of piston or valve rods; or, in VALVES of any size or shape, for hot or cold water pumps, vacuum pumps, etc. It is sometimes the case that interruption to the working of steam machinery, in consequence of the giving out or failure of rubber valves or packing of a poor quality, causes serious loss and delay. Our reputation and experience as manufacturers is a guarantee to dealers and consumers that any article made by us will satisfactorily answer the purpose for which it may be designed.

GUM PACKING WITH CLOTH INSERTION,

OR CLOTH ON ONE OR BOTH SIDES.

Thickness.	1-ply, per lb.	2-ply, per lb.	3-ply, per lb.	4-ply, per lb.
1/64 inch	70 cents.	.....	.....	.....
1/32 "	65 "	.....	.....	.....
1/16 "	60 "	63 cents.	66 cents.	.....
3/32 "	55 "	58 "	61 "	.....
1/8 "	.....	55 "	58 "	61 cents.
3/16 "	.....	.....	55 "	58 "
1/4 "	.....	.....	.....	55 "

One ply of cloth for every 1/16 inch thickness.

THREE CENTS additional per pound will be charged for each extra ply of cloth.

Each cloth, whether insertion or on outside, to count as one ply.

FIBROUS GASKETS OR RINGS.

	Price.
1/8 inch or less, per pound	90 cents.
3/32 inch and upwards, per pound	80 "

CLOTH INSERTION GASKETS AND RINGS.

Thickness.	Price.
1/16 inch or less, per pound	$1 25
3/32 inch and upwards, per pound	1 00

There is one ply of cloth to every 1/16 inch thickness.

Five cents per pound additional will be charged for each extra ply of cloth.

	Per pound.
Pure Sheet Packing or Valve Gum	$1 40
Pure Valves, Gaskets, and Rings	1 50
Round and Square Piston Packing, from best Cotton Duck	85
Square Piston Packing, with Elastic Back	1 00

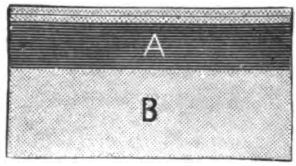
SQUARE PACKING,

WITH ELASTIC RUBBER BACK,

FOR PACKING THE PISTON RODS AND VALVE STEMS OF STEAM ENGINES AND PUMPS.

PATENTED JANUARY 26, 1869.

SIDE VIEW.



END VIEW.

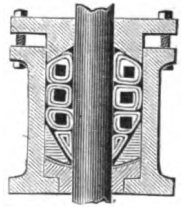
B Represents that part of the packing which, when in use, is in contact with the Piston Rod.

A The elastic back, which keeps the part B against the rod with sufficient pressure to be steam tight, and yet creates but little friction.

The part "B" is made of successive thicknesses of cotton duck, firmly cemented together with an elastic lubricative compound. When in use, the *edges* of the cotton fabric are brought in contact with the Piston Rod, so that the wear is very slow, and hence the packing is very durable. Its convenience, durability, and satisfactory working must commend it to the favor of Engineers wherever it is tried, and lead to its general use.

PRICE, $1.00 PER POUND.

TUCK'S ROUND PACKING,

WITH ELASTIC  RUBBER CORE,

FOR PACKING THE PISTON RODS AND VALVE STEMS OF STEAM ENGINES AND PUMPS.

This packing is made of cotton duck, saturated with a lubricative compound, and rolled into a compact form around a rubber core, or centre, and is more elastic, and creates less friction in use, than any other kind. All sizes from one-quarter to two inches diameter on hand, in lengths of twelve feet.

PRICE, 85 CENTS PER POUND.

"SALAMANDA" PACKING.

SELF-VULCANIZING.

PRICE, 80 CENTS PER POUND.

Kept on hand in sheets $\frac{1}{32}$, $\frac{1}{16}$, $\frac{3}{32}$, $\frac{1}{8}$, $\frac{3}{16}$, and $\frac{1}{4}$ in. thick.

Other sizes, Gaskets, Rings, etc., furnished at short notice.

Scraps of "Salamanda" Packing can be returned at full value, less cost of rerolling.

DIRECTIONS:

SCREW TIGHT WHEN COLD.

If joint leaks when steam is let on, then screw up till leak stops, but no more than is necessary to stop leak.

Cut bolt holes a little less than the diameter of bolts. As this packing is not vulcanized it will be soft as soon as heat is applied, but soon becomes hard. In order to break joints, apply to *one* side of the packing a paste made of black lead and water. Chalk or paper will also answer the same purpose.

WARRANTED TO BE SUPERIOR TO ANY OTHER UNVULCANIZED PACKING IN THE MARKET.

India-Rubber Ball Valves.

Diameter.	Per dozen.	Diameter.	Per dozen.	Diameter.	Per dozen.
1 inch or less	$1 00	1⅞ inches	$5 50	3½ inches	$23 50
1⅛ "	1 40	2 "	6 50	3¾ "	29 25
1¼ "	1 90	2¼ "	8 00	4 "	35 00
1⅜ "	2 50	2½ "	10 50	4½ "	54 50
1½ "	3 25	2¾ "	13 00	5 "	70 00
1⅝ "	4 00	3 "	15 50	6 "	115 00
1¾ "	4 75	3¼ "	19 50		

Pure Cord.

¼ inch	$2 00 per lb.	¾ inch	$1 60 per lb.
⅜ "	1 75 "	⅞ "	1 60 "
½ "	1 65 "	1 " and larger	1 50 "
⅝ "	1 65 "		

Tubing.

IN LENGTHS OF TWELVE FEET.

Pure Tubing. Internal Diameter.	Per foot.	Pure Tubing. Internal Diameter.	Per foot.	Pure Tubing. Internal Diameter.	Per foot.
⅛ inch	8 cents.	5/16 inch	18 cents.	⅝ inch	30 cents.
3/16 "	12 "	⅜ "	20 "	¾ "	35 "
¼ "	16 "	½ "	25 "	1 "	45 "

With Cloth Insertion. Internal Diameter.	Per foot.	With Cloth Insertion. Internal Diameter.	Per foot.	With Cloth Insertion. Internal Diameter.	Per foot.
⅛ inch	10 cents.	5/16 inch	20 cents.	⅝ inch	38 cents.
3/16 "	14 "	⅜ "	23 "	¾ "	38 "
¼ "	18 "	½ "	28 "	1 "	50 "

Pure Rubber Cement.

	Per dozen.
No. 3 (half pints)	$3 60
No. 2 (pints)	7 20
No. 1 (quarts)	14 40

CORRUGATED RUBBER MATTING,

MATS, TRACKERS, AND TREADS.

HALLS, FLOORING, STONE AND IRON STAIRWAYS, STEPS, &c.

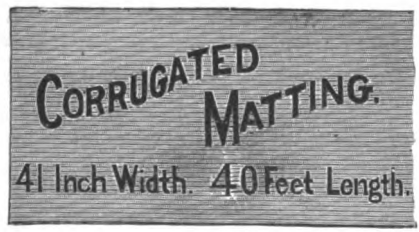
This practical and indispensable article—especially for wear where exposed to ice, mud, snow, or slush—was first introduced by this Company several years ago, and its splendid record will show its immense value in being almost indestructible, when proper materials are used in its manufacture, whilst the cheap, inferior quality, forced on the public by reckless imitators of our goods, soon becomes hard and crumbles to pieces.

This style of Rubber Mats, recently patented, is by far superior in every way to any in the market. The price is half and durability double that of any Rubber Mat now in use. They are especially adapted for out-door purposes, and are extensively used around Billiard Tables, Railroad Cars, etc.

Over thirty thousand square feet of Corrugated Matting of our manufacture has been used for the last three years in Philadelphia alone, giving, in every instance, perfect satisfaction. It is used and may be seen in the U. S. Naval Asylum, Pennsylvania Railroad Offices and Depot, Post Office, Girls' Normal School, Court House, Hotel Brunswick, Delmonico's, etc.

Purchasers are especially warned that unless proper materials are used in its manufacture, the goods soon become worthless. Our name is stamped on the back of every piece made by us.

Patented January 14, 1868.



Reissued July, 1870.

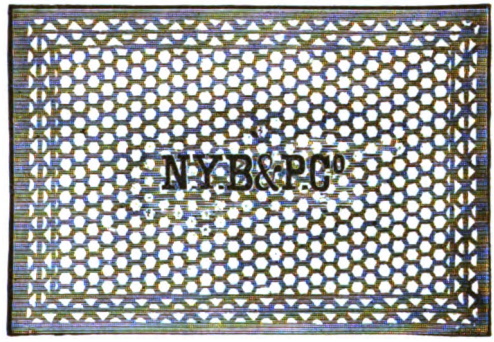
MATTING.

3/16	inch thick	....	per square foot,	$0 33		1/4	inch thick	...	per square foot,	$0 78
1/8	"	....	" "	40		3/8	"	....	" "	1 08
3/16	"	....	" "	56		1/2	"	....	" "	1 30

PERFORATED MATS.

¼ inch thick ..... $0.75 per square foot.
⅜ " " ..... 1.00 " "
½ " " ..... 1 25 " "

Made to order of any size required. Lettering, 25 cents per letter extra.



These Mats can be made to order any size up to 58 inches by 15 feet or 40 inches by 20 feet.

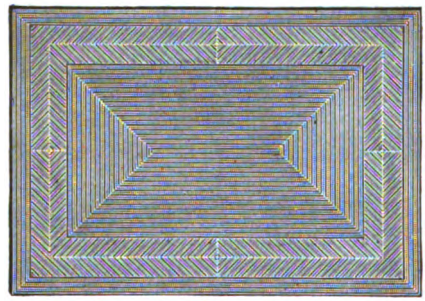
CORRUGATED STAIR TREADS

				Per doz.
No. 1,	6 x18 inches	⅛	thick,	$4 00
" 2,	7 x24 "	⅛	"	6 00
" 3,	4 x39 "	⅛	"	5 50
" 4,	7 x40 "	⅛	"	10 00
" 5,	7½x42 "	⅛	"	11 00
" 6,	7½x48 "	⅛	"	12 50
" 7,	9 x40 "	⅛	"	12 50
" 8,	9 x48 "	⅛	"	15 00
" 9,	9 x36 "	⅛	"	11 25
" 10,	6 x48 "	⅛	"	10 20
" 11,	7 x28 "	⅛	"	7 00
" 12,	9 x54 "	⅛	"	16 80
" 13,	8 x52 "	⅛	"	14 60
" 14,	10 x24 "	⅛	"	8 40

		Per doz.
⅜	thick,	$3 30
⅜	"	5 00
⅜	"	4 70
⅜	"	8 80
⅜	"	9 10
⅜	"	10 40
⅜	"	10 40
⅜	"	12 50
⅜	"	9 40
⅜	"	8 50
⅜	"	5 85
½	"	14 00
½	"	12 15
½	"	7 00

CORRUGATED RUBBER MATS.

PATENTS 11,208 and 213,601.



Any size Mats, varying from the ones on the Price List, can be made by special order, with an advance charge of $4.00 for the first dozen.

			Per doz.
No. 0,	18x 18 inches,	1/8 thick,	$11 00
" 1,	17x 31 "	1/8 "	18 50
" 1½,	24x 24 "	1/8 "	20 00
" 2,	23x 36 "	1/8 "	28 50
" 3,	24x 70 "	1/8 "	56 50
" 4,	24x108 "	1/8 "	86 00
" 5,	24x120 "	1/8 "	96 00
" 6,	16x 32 "	1/8 "	18 00
" 7,	18x 36 "	1/8 "	21 50
" 8,	38x 48 "	1/8 "	61 00
" 9,	42x 96 "	1/8 "	135 00
" 10,	42x 48 "	1/8 "	68 00
No. 11,	24 x186 inches,	1/8 thick,	$150 00
" 12,	36 x 72 "	1/8 "	87 00
" 13,	18 x 54 "	1/8 "	33 00
" 14,	36 x 96 "	1/8 "	116 00
" 15,	32 x113 "	1/8 "	122 00
" 16,	24 x 34 "	1/8 "	27 25
" 17,	17 x 29 "	1/8 "	16 75
" 18,	22½x 36 "	1/8 "	27 90
" 19,	24 x 48 "	1/8 "	40 00
" 20,	25⅝x 54¼ "	1/8 "	46 75
" 21,	20 x 30 "	1/8 "	20 00

These Goods are for sale by all large Carpet Houses. A Large Stock always on hand.

CAR SPRINGS.

OUR BEST SPRINGS HAVE NEVER FAILED TO DO GOOD SERVICE

WRITE FOR PRICES.

WAGON SPRINGS, BUMPERS, AND CYLINDER SPRINGS.

PRICES ACCORDING TO QUALITY.

ANTI-SHAFT-RATTLERS.

PRICES ACCORDING TO QUALITY.

Billiard Cushions in Large Variety.

DIAPHRAGMS ON HAND AND MADE TO ORDER.

BICYCLE TIRES.

We make to order large quantities of Bicycle Tires, of different qualities, suitable to the purpose required.

GRAIN DRILL TUBES.

Our facilities for manufacturing Grain Drill Tubes are very large, and we are able to furnish large quantities at short notice.

WRINGER ROLLS, BRAKE PIPE, AND BLACK TUBING

On hand or made to order in various sizes.

EMERY WHEELS.

TO MANUFACTURERS OF

HARDWARE, EDGE TOOLS, PLOWS, STOVES,

AGRICULTURAL IMPLEMENTS,

—AND—

WORKERS IN IRON AND STEEL GENERALLY.

WE INVITE YOUR SPECIAL ATTENTION TO

Our Solid Emery Vulcanite Wheels,

for grinding and polishing metals, they having been thoroughly tested during the past twenty years, and successfully adopted in hundreds of the best manufacturing establishments throughout this country and in Europe.

For "gumming" or sharpening saws, no process is so simple, rapid, and effective. By the use of one of these wheels a circular saw, six feet diameter, can in two hours be thoroughly "gummed," and the teeth deepened to any extent required.

FOR TURNING OFF AND TRUING WHEELS

—USE THE—

DIAMOND TURNING TOOL,

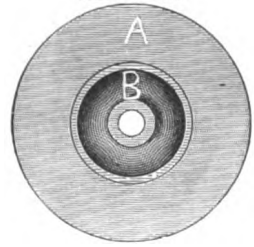
Patented April 6, 1869

Lathe Diamond Turning Tools—ordinary size.... ....$20.00 each.
Hand " " " " " ..... 18.00 "

TRADE

MARK.

SIDE VIEW.



SECTION.

Section of Emery Wheel showing Iron Centre.

A—Emery Vulcanite Rim. B—Cast Iron Centre.

N. B.—The ends of the hub must be flush with the sides of the wheel, as drawn, and not project beyond.

Large Wheels made on Cast Iron Centre if desired.

PRICE LIST

—OF—

SOLID EMERY VULCANITE WHEELS,

MADE BY THE

New York Belting and Packing Co.

Diameter in Inches.	THICKNESS IN INCHES.													Revolutions per minute.
	¼	⅜	½	1	1¼	1⅜	1¾	2	2½	3	3½	4	5	6	
1½	$0 25	$0 35	$0 40	$0 45	$0 50	$0 55	$0 60	$0 65	$0 75	$0 90	$1 00	$1 15	.....		12000
2	32	45	50	55	60	65	72	80	95	1 15	1 30	1 50	.....	.....	12000
2½	45	65	70	75	82	90	1 02	1 15	1 40	1 65	1 90	2 15	.....	.....	8000
3	55	75	90	1 05	1 15	1 25	1 37	1 50	1 80	2 15	2 55	2 85	.....	.....	6700
3½	65	90	1 07	1 25	1 45	1 65	1 80	1 95	2 45	2 90	3 30	3 75	.....	.....	5800
4	75	1 00	1 25	1 50	1 75	2 00	2 25	2 50	3 05	3 60	4 20	4 75	.....	.....	5000
5	95	1 25	1 57	1 90	2 30	2 70	3 07	3 45	4 30	5 15	6 00	6 90	.....	..	4000
6	1 15	1 55	2 15	2 75	3 40	4 05	4 55	5 05	6 30	7 55	8 80	10 00	.....	.....	3344
6½	1 40	1 90	2 52	3 15	3 77	4 40	5 00	5 60	7 05	8 45	9 90	11 25	.....	.....	3085
7½	1 65	2 20	2 97	3 75	4 57	5 40	6 17	6 95	8 65	10 35	12 15	13 95	.....	.....	2674
8	1 75	2 35	3 20	4 05	4 95	5 85	6 75	7 65	9 45	11 25	13 25	15 00	.....	.....	2520
8½	1 85	2 50	3 45	4 40	5 35	6 30	7 20	8 10	10 35	12 15	14 40	16 20	.....	.....	2363
9½	2 35	3 15	4 40	5 65	6 75	7 85	8 92	10 05	12 60	15 10	17 60	20 15	.....	.....	2111
10½	2 60	3 45	4 87	6 30	7 55	8 80	10 02	11 25	14 15	17 10	19 80	22 50	.....	.....	1910
12	2 70	3 60	5 17	6 75	8 32	9 90	11 25	12 60	15 75	18 90	22 00	23 25	.....	.....	1672
14	4 20	5 60	7 85	10 10	12 05	14 00	15 75	17 50	22 00	26 50	31 00	35 00	.....	.....	1435
16	5 40	7 00	10 00	13 00	15 25	17 50	19 75	22 00	28 50	33 50	37 00	45 00	$56 00	$67 00	1254
18	6 30	8 50	13 25	16 00	19 00	22 00	25 50	29 00	36 00	48 00	50 00	57 00	71 00	85 00	1115
20	7 00	10 00	14 50	19 00	22 50	26 00	30 50	35 00	44 00	52 00	61 00	70 00	87 00	105 00	1003
22	9 00	12 00	17 00	22 00	26 50	31 00	35 50	42 00	53 00	63 00	74 00	84 00	105 00	126 00	920
24	10 00	14 00	20 00	26 00	32 00	38 00	44 00	50 00	63 00	75 00	88 00	100 00	125 00	150 00	836
26	12 00	15 00	22 50	30 00	37 00	44 00	51 00	58 00	74 00	89 00	102 00	117 00	146 00	175 00	771
30	15 00	21 00	30 50	40 00	50 00	60 00	69 00	78 00	98 00	118 00	138 00	157 00	196 00	235 00	668
36	23 00	30 00	44 00	58 00	71 00	84 00	98 00	112 00	140 00	169 00	197 00	225 00	281 00	337 00	558
48	42 00	54 00	78 00	102 00	126 50	151 00	176 00	201 00	252 00	301 00	355 00	405 00	508 00	607 00	420

All Orders for Wheels must specify distinctly the Diameter, Width, Size of Hole in the Center, and Grade of Emery required.

The grades of Emery used are numbered

8, 10, 12, 14, 16, 20, 24, 30, 36, 40, 46, 54, 60, 70, 80, 90, 100,

Number 8 being the coarsest and 100 the finest.

Pamphlet giving full description to be had on application.